Novel Fiber Optic Transceiver Module

The present invention concerns a novel fibre optic transceiver for use in a telecommunications system. Specifically, the present invention concerns a fibre optic transceiver in which the optical components, interface, management functionality and management interface are all integrated on a single module capable of being plugged into and removed from the telecommunication's parent system.

In order to meet demand for increased speed and capacity, optical telecommunications systems are being developed in which data is transmitted at a rate of 10Gbit/s per second. The implementation of 10Gbit systems has to overcome the fundamental problems of interfacing high frequency signals from an optical module to a customer's system. Connectors suitable for 10Gbit operation are both costly and difficult to utilize.

Figure 1 shows a known optical transceiver module which is connected to the telecommunications system (not shown) via a rail type arrangement. Here transceiver 100 is inserted into chassis 101 which must be first mounted onto base plate 102. This current arrangement is costly and suffers from poor electromagnetic (EMI) shielding.

Emerging standards for 10Gbit systems require successful integration of 10Gbit integrated circuits (IC's) with suitable multiplexer, demultiplexer and framing functionality. This alone is a considerable technical challenge facing implementation of 10Gbit optical solutions. Furthermore, customers require that the transceiver modules are removable, known in the field as "hot pluggability". Once the addition of management functions via a management

interface are included, the resulting implementation is large, costly and inefficient in terms of power usage.

Current systems utilize 10Gbit serial or wavelength division multiplexing (WDM) transceiver modules which demultiplex the 10Gbit signal into a number of lower speed signals. These low speed signals are then interfaced to system boards containing the higher functionality requirements. These systems typically require 8 to 16 low speed signals to reduce the interface problems to an acceptable level. In multiple implementations this results in the technical problem of routing a large number of signal traces both in the module and on the customer's board. In addition these systems tend to be customer specific and the achievable performance is dependent on the particular combination of integrated circuits (IC's) used.

Thus, it is an object of the present invention to overcome, or at least mitigate, the above mentioned technical problems.

According to the present invention there is provided an optical transceiver module comprising a housing having disposed therein a transmitter and a receiver, characterized in that said housing further comprises a pair of rails disposed on opposite sides of said housing, said rails having a plurality of spring-like fingers arranged to enable said module to be removably inserted into a suitably configured board.

According to a further aspect of the present invention there is provided an optical transceiver system comprising the module described above, wherein said system further comprises a chassis having said suitably configured board

disposed therein, and chassis electrical connector means arranged to receive said module electrical connector means

The present invention overcomes these problems by integrating all the requirements into a single module capable of being plugged into or removed from an operational parent system. The use of specifically designed components in a defined environment results in an easy to use, efficient solution to 10Gbit implementations. The present invention covers all implementations of high-speed optical transceivers such as WDM, serial, single mode and multimode. The present invention is applicable to transceivers operating at speeds other than 10Gbits. The resulting family of transceivers allows customers access to modules of defined performance and has the flexibility to upgrade or change system configurations by exchanging module types.

The industry standard XAUI interface uses four channels of data each typically running at 3.125Gbit/s. By utilizing a PCB connector designed to operate at such speeds the module, according to the present invention, can be easily interfaced to system boards whilst significantly reducing the number of PCB traces and interconnections required.

While the principle advantages and features of the invention have been described above, a greater understanding and appreciation of the invention may be obtained by referring to the drawings and detailed description of the preferred embodiments, presented by way of example only, in which;
FIGURE 2 shows an elevated view of the module,
FIGURE 3 shows an elevated view from the rear of the module,
FIGURE 4 shows a side view along the length of the module,

FIGURE 5 shows an elevated view of a chassis suitable for receiving the module shown in figures 1 to 4,

FIGURE 6 shows an elevated view of the chassis with the module inserted,

FIGURE 7 shows a further side view along the length of the module,

FIGURE 8 shows a more detailed view of the module,

FIGURE 9 shows a more detailed elevated view of the module,

FIGURE 10 shows an elevated rear view of the chassis with the module inserted, and

FIGURE 11 shows a detailed view of the rear of the chassis with the module inserted.

In figure 2, the fibre optic transceiver module 1 according to the present invention is shown comprising housing 2, bezel 3, apertures 4 and 5, rail means 6, and module PCB connector means 7. The housing and bezel are preferably made of metal. However, other suitable material, such as a suitably loaded polymer could be used. The housing is configured with a series of fins 9, which are arranged in rows and act as heat sinks. The apertures provide access to the internal components of the module. Aperture 4 provides access to an optical signal receiver (not shown) and aperture 5 provides access to an optical signal transmitter (not shown). Alternatively, aperture 4 can provide access to the receiver and aperture 5 can provide access to the transmitter.

In the preferred embodiment shown in figure 2 the apertures 4, 5 are of the type suitable for receiving optical fibres fitted with SC type connectors. However, other connector types, such as LC, could be used without departing from the scope of the invention.

Rail means 6 are disposed on the sides of the housing in a manner so that the module can be inserted into a motherboard, with the rail means acting as a guide. The rail means may further act to support the module once inserted into the chassis. As will be apparent, a further rail means (not visible in figure 2) is disposed on the opposite side of the housing.

The PCB connector means 7 is disposed at the rear of the module. The PCB connector means function to establish electrical connection between the module and the parent system.

In figures 3 and 4, where parts also appearing in figure 2 bear identical numerical designation, the PCB connector means can be seen more clearly, as can fins 9. The PCB connector means may further function to provide mechanical support for the module while inserted in the chassis.

As can be seen in figure 4, module 1 consists of an upper half 110 and a lower half 112. During assembly the upper and lower halves are sandwiched together and held together by suitable connection means such as screws 118. An electrically conductive gasket 115, known in the art as an EMI gasket, is disposed between the upper and lower halves. The EMI gasket functions to ensure good electrical connection between the two halves. In the embodiment shown here the module is approximately 4 inches long, 1.5 inches wide, and 1 inch tall. However, as will be appreciated, the module could have other dimensions without departing from the scope of the present invention.

It is known in the field of optical transceivers that good electrical ground connections are essential for optimum system performance. Establishing and

maintaining good electrical ground connections is a key aspect of the present invention.

Figure 5 shows chassis 30 comprising base plate 31 connected to front plate 32. The front plate includes openings 33, 34 which are suitable for receiving modules according to the present invention. The chassis further includes motherboard 35 connected to the base plate and arranged to receive rail means 6 during insertion of the module into the chassis. After insertion of the module the motherboard functions to provide support for the module. The motherboard shown in figure 5 is arranged to receive two modules. However, as will be appreciated, the motherboard can be arranged to receive any number of modules, depending on the system design.

At the rear of the chassis is disposed a system PCB connector 37 arranged to receive module PCB connector 7 thereby establishing electrical connection between the module and the parent system. The PCB connectors 7, 37 are preferably multiway edge connectors.

To the sides of system PCB connector 37 are disposed shield means 36. The shield means is made of metal and arranged so as to reduce the amount of electromagnetic radiation being emitted from the area of PCB connection.

The chassis base plate and front plate are preferably made of metal.

The front plate has a plurality of small apertures 39 disposed therein. These small apertures are arranged around the openings 33, 34 and function to allow the module to be secured in place in the chassis.

The chassis shown in figure 5 has two openings 33, 34 and is suitable for the insertion of two modules. However, as per the motherboard, the chassis may be configured to receive any number of modules, depending on the requirements of the parent system. For example, in figure 6, where parts also appearing in figures 2-5 bear identical numerical designation, chassis 30 is shown with a single module inserted into opening 34 of the chassis. In this example opening 33 has no module inserted and is covered by dummy plate 40. Alternatively, a dummy module could be used to preserve air flow characteristics. Both module 1 and dummy plate 40 are secured in place by captive fasteners 41.

In a further aspect of the invention which is best demonstrated in figures 2 and 6, bezel 3 of module 1 is arranged with an upper arm 20 and lower arm 22, each extending from diagonally opposite corners of the bezel. By arranging the bezel in this manner a plurality of modules can be inserted into the chassis at a closer spacing, thus reducing the overall size of the chassis needed for a given number of modules. Furthermore, by arranging the bezel as shown in figures 2 and 6, improved access to the captive fasteners 41 is gained, thus furthermore improving the ease in which modules can be inserted and removed from the system.

As best seen in figures 3 and 6, a further EMI gasket 240 is disposed behind the bezel. This further EMI gasket functions to establish good electrical connection between bezel 3 and front panel 32 when the module is secured in place, thus helping to improve the overall electrical grounding of the system.

As previously mentioned, and now shown in more detail in figures 7, 8 and 9, where parts also appearing in figures 2-6 bear identical numerical designation,

rail means 6 comprises a plurality of spring like fingers 260 flexibly attached to an interposer 262. The spring fingers and interposer are preferably made of metal and form a single piece part. As will be appreciated, a substantially identical rail means is disposed on the opposite side of the module.

The rail means are inserted into a groove 270 formed in the housing. The spring fingers are arranged so as to accept a range of motherboard thickness, while still securely holding the module in place. For example, the spring fingers are arranged to accept motherboards with thickness ranging from 2mm to 3.1mm.

As a further feature of the present invention, the motherboard is supported by a plurality of mounting pillar 250. By arranging the motherboard as such, air is able to flow both above and below the module, advantageously improving cooling of the module.

As shown in figures 10 and 11, module PCB connector means 7 is plugged into system PCB connector 37. Shield means 36 is disposed over connectors 7 and 37 in order to contain electromagnetic emission and to help further improve the electrical ground of the system. The shield means may include a plurality of resilient fingers 420 which exert pressure on a rear extending portion of the housing 425 when the module is fully inserted into the chassis. These resilient fingers function to ensure good electrical connection between the shield means and the module.

In figure 11 a portion of shield 36 has been removed to better show connectors 7 and 37. As will be appreciated with multi way type connectors, the height of connector 7 must be precisely aligned to connector 37 in order

for connection to be made. The rail means in general, and specifically the spring fingers, function to ensure that module connector 7 is at the correct height for connection to be made to system connector 37.

In a further embodiment of the present invention, and as seen in figure 10, a thin layer of gold 400 or other suitable metal is disposed on the motherboard around where module 1 is inserted. The presence of the gold layer, which is shown by the dashed line pattern 400, is to establish electrical connection between the rail means and the front plate and base plate of the chassis. Preferably, shield means 36 is soldered to the gold layer. Thus an area of electrical connection is established surrounding the module, which can then easily be connected to a customer's own ground connection.

Advantageously, a module according to the present invention, can be easily inserted and removed from the chassis. Furthermore, additional modules or replacement modules can be easily inserted, thus providing a totally pluggable system.

The module and chassis described above are preferably configured to operate in a 10Gbit serial optical Ethernet system. To this effect the module is configured as an optical transceiver operating at a wavelength of 1300nm with sufficient power to operate over a 10 kilometer single mode optical fibre link. However, the module concept is equally applicable for use at other speeds and at different wavelengths, as well as over different distances and with different types of fibres.

In a further embodiment of the present invention, the module includes all the functional controls needed for a 10Gbit transceiver. The functional controls

preferably include an XAUI interface, management functionality, and a management interface. The management interface is preferably an MDIO interface. The XAUI interface and management functions are preferably implemented on an ASIC disposed within the module, enabling direct connection to a 10Gb Media Independent Interface.

Preferably the module further includes two subassemblies: a transmitter optical subassembly with a directly modulated laser and a receiver subassembly with a photodiode and transimpedance amplifier. The laser drive, MUX receiver post-amplification and DEMUX functions are achieved using custom ASICs.

Advantageously, the module is able to convert full duplex XAUI electrical signals into full-duplex-optical signals. Management of the transceiver and optical links is managed via the MDIO. The XAUI interface operates at 3.125Gbaud, and the electrical connection is via a hot pluggable connector.